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DEVELOPMENT OF STROPHARIA EPIMYCES

W. B. McDougall

(WITH TEN FIGURES)

Stropharia epimyces (Peck) Atk. was first described by Peck (9) in 1884 as *Panaeolus epimyces*. It was redescribed by Atkinson (1) in 1902 and again in 1907 (2), and placed in the genus *Stropharia* because of the purplish tinge of the spores and the presence of an annulus. It is considered rare, but it has occurred in several localities north of Urbana during each of the 4 summers I have spent in Illinois, and was particularly abundant during the seasons of 1915 and 1916.

As is well known, this plant always occurs as a parasite on another mushroom. The identification of the host plant was first published by Atkinson (1) as *Coprinus atramentarius*. Later a second host, *C. comatus*, was added by Sherman (10). All specimens collected at Urbana have been on *C. comatus*. Several photographs of *Stropharia epimyces* and its host were published by McDougall (8), and excellent photographs were also published by Atkinson (2).

Material for the developmental study of this plant was obtained within the city park of Urbana in Spetember 1915. It was imbedded, sectioned, and stained with fuchsin.

Development

The smallest carpophore sectioned measured 0.9 mm. by 1.2 mm. (fig. 1). In this the pileus and stem fundaments cannot be said to be differentiated, but the primordium of the hymenophore already appears as a patch of heavily stained hyphae on each side of the median longitudinal section. Aside from this hymenophore primordium there is no differentiation of the carpophore at this stage, except a layer of coarse and rather loose hyphae on the periphery, representing the universal veil or blematogen. The size of the carpophore is not always an index of its degree of development, since the carpophore shown in fig. 2 is considerably larger, although little if any further developed than that shown in fig. 1; but in any case the first internal differentiation is the appearance of the hymenophore primordium.

The rapid growth of the elements of the hymenophore as the carpophore enlarges, together with the cessation of growth, or at least very slow growth of the ground tissue below the hymenophore primordium, soon cause the formation of an annular gill cavity (figs. 3, 4). The presence of the annular gill cavity makes it easy to see in longitudinal section which parts of the carpophore in general belong to the pileus fundament and which to the stem fundament, but it is not until still later that these are clearly distinguished.

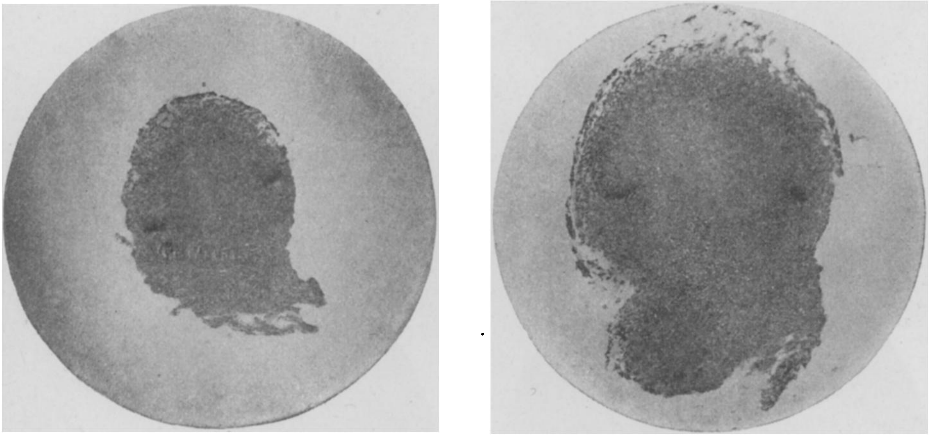

FIG. 1 FIG. 2

FIGS. 1, 2.—*Stropharia epimyces:* fig. 1, small carpophore showing primordium of hymenophore as only differentiation; fig. 2, larger specimen at same stage of development.

The gill cavity enlarges rapidly (fig. 5), but it does not become very large before the formation of the lamellae by the downward growth of hyphae from the hymenophore begins (figs. 6, 7). By this time also, if not earlier, the universal veil has disappeared, and the mature carpophore is without any trace of it. ATKINSON (4) has explained in detail the development of the lamellae in

Agaricus Rodmani. The development in our plant is similar and therefore the details need not be repeated here. The same author has explained the rather deceptive "stalls" or "pigeon holes" formed by the lamellae at the stem end in longitudinal sections of carpophores in which the lamellae are attached to the stem.

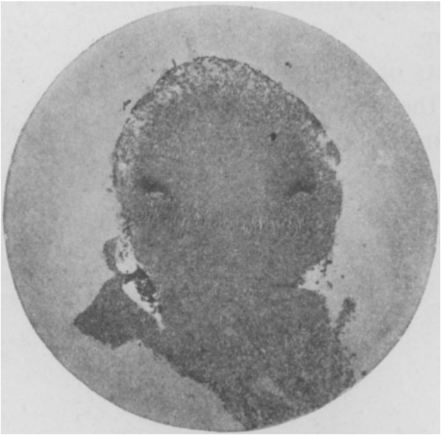

FIG. 3

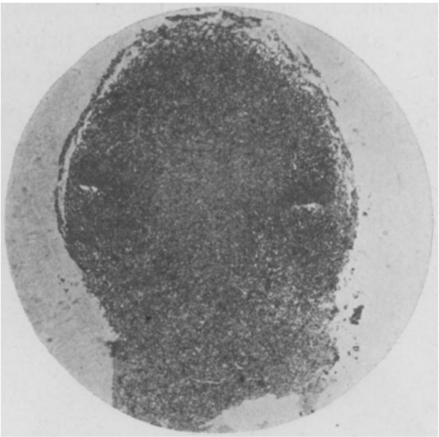

FIG. 4

FIGS. 3, 4.—*Stropharia epimyces:* stages in development of annular gill cavity.

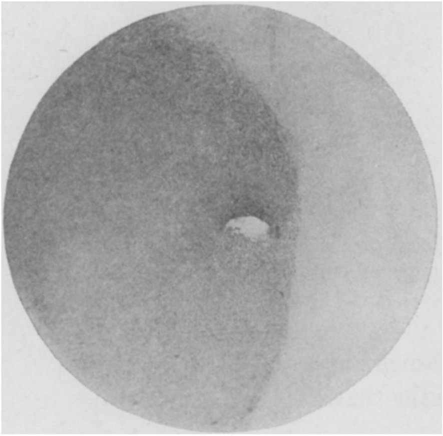

FIG. 5

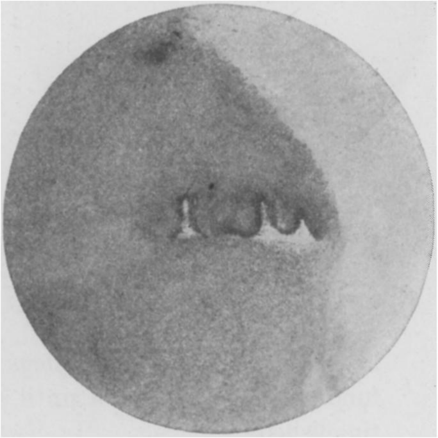

FIG. 6

FIGS. 5, 6.—*Stropharia epimyces:* fig. 5, late stage in development of annular gill cavity; fig. 6, early stage in development of lamellae.

Such "stalls" are shown in figs. 8 and 9, and prove that the lamellae are attached to the stem at this stage of development.

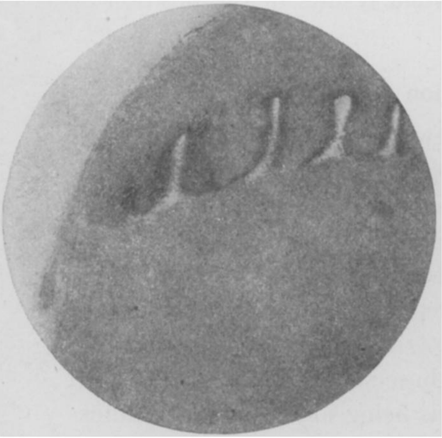

FIG. 7

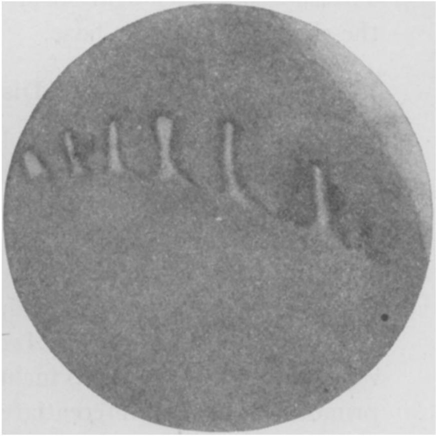

FIG. 8

FIGS. 7, 8.—*Stropharia epimyces:* fig. 7, late stage in development of lamellae; fig. 8, similar stage cut to show "stalls," indicating that gills are attached to stem.

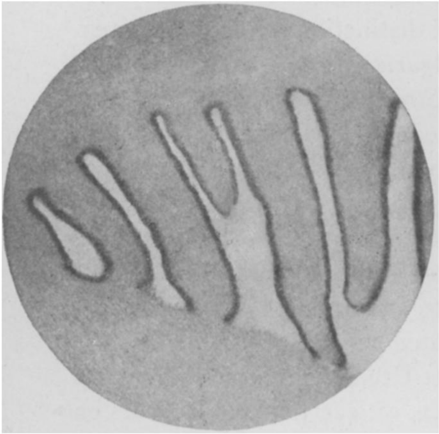

FIG. 9

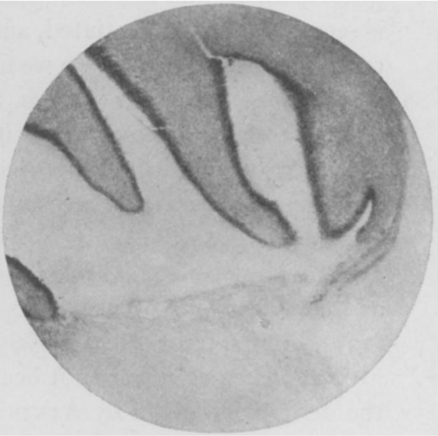

FIG. 10

FIGS. 9, 10.—*Stropharia epimyces:* fig. 9, portion of expanding carpophore showing "stalls," indicating that gills are attached to stem; fig. 10, portion of expanding carpophore showing the rather slight inner veil.

The inner veil which develops from the ground tissue below the hymenophore primordium remains intact until the lamellae are well developed, but it usually ruptures before the stem is much elongated (fig. 10) and forms a rather slight ring on the stem. The subsequent elongation of the stem results in the position of the ring near the stem base.

Discussion

As ATKINSON (5) has said, the few species of Agaricaceae with endogenous origin of the hymenophore, whose development has been studied, fall into 3 groups, based on the order of differentiation of the pileus, stem, and hymenophore fundaments in the carpophore. In the first of these groups the pileus primordium is differentiated first. This group is represented by *Hypholoma sublateritium*, *H. fasciculare*, *Amanita rubescens*, and *Amanitopsis vaginata*. A second group includes those species in which the stem primordium is first differentiated, this being followed by the differentiation of the pileus primordium and later of the hymenophore primordium. This group is represented by *Lepiota cristata*, *L. seminuda*, and *Rozites gongylophora*. In the third group the hymenophore primordium appears while the remainder of the carpophore is seemingly undifferentiated, and the distinction of pileus and stem comes later. In this group we find *Agaricus campestris*, *A. arvensis*, *A. Rodmani*, *Armillaria mellea*, and *Stropharia ambigua*.

Stropharia epimyces, from its mode of development, is to be placed in the third group mentioned. This may be taken as additional evidence, if any further evidence is needed, that our plant belongs to the genus *Stropharia* and not to *Panaeolus*, as was first thought by PECK, since the type of development is the same as that of the only other species of *Stropharia* that has been studied (11) and of species of the closely related genus *Agaricus*.

Stropharia epimyces as it occurs at Urbana agrees in detail with the description given by ATKINSON (1, 2), except that it occurs on *Coprinus comatus* instead of *C. atramentarius* as did those collected by ATKINSON. The recognition of the host plant was easy in this case since there were many uninfected plants growing along with the infected ones, and also many plants which had "pinhead" and "button" stages of the parasite on them but were not deformed to such an extent as to be unrecognizable. The spores are distinctly purple-black in color. The annulus is often not very prominent, but is usually perfectly apparent. The lamellae in mature specimens are adnate to adnexed.

HARPER (6, 7) has suggested that *Stropharia epimyces* is identical with *Pilosace algeriensis* (Fries) Quel. While it is entirely possible that this may be true, our plant cannot belong to *Pilosace*, as we understand that genus, since it has an annulus and the lamellae are not free.

The fact that all species of *Agaricus* and *Stropharia* thus far studied (*Agaricus comtulus*, see ATKINSON, 3, is a possible exception) develop in the same way is of interest as indicating a close relationship between these two genera. The main taxonomic characters that have been used to distinguish these genera are the free gills in *Agaricus* and the attached gills in *Stropharia.* ATKINSON (4), however, has found that in developmental stages of *Agaricus Rodmani* the gills are often attached, and that even in mature specimens of *A. Rodmani* and *A. campestris* the gills are sometimes adnexed, thus indicating that such characters do not clearly distinguish the genera.

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LITERATURE CITED

1. ATKINSON, G. F., Preliminary notes on some new species of fungi. Jour. Myc. 8:110–119. 1902.
2. ———, A mushroom parasitic on another mushroom. Plant World 10:121–130. 1907.
3. ———, The development of *Agaricus arvensis* and *A. comtulus.* Amer. Jour. Bot. 1:3–22. 1914.
4. ———, The development of *Lepiota cristata* and *L. seminuda.* Mem. N.Y. Bot. Gard. 6:209–224. 1916.
5. ———, The development of *Agaricus Rodmani.* Proc. Amer. Phil. Soc. 54:309–343. 1915.
6. HARPER, E. T., The probable identity of *Stropharia epimyces* (Peck) Atk. with *Pilosace algeriensis* Fries. Mycologia 5:167–169. 1913.
7. ———, Two parasitic mushrooms. Mycologia 8:65–71. 1916.
8. McDOUGALL, W. B., Some interesting mushrooms of Champaign County. Trans. Ill. Acad. Sci. 9:125–128. 1916.
9. PECK, C. H., Report of the State Botanist. N.Y. State Mus. Nat. Hist. Bull. 133. 1884.
10. SHERMAN, HELEN, The host plants of *Panaeolus epimyces* Peck. Jour. Myc. 11:167–169. 1905.
11. ZELLER, S. M., The development of *Stropharia ambigua.* Mycologia 6:139–144. 1914.